

Precision Foreground Removal in Cosmic Microwave Background Polarization Maps

Completed Technology Project (2016 - 2020)



Project Introduction

The most promising method for detecting primordial gravitational waves lies in the B-mode polarization of the cosmic microwave background, or CMB. A measurement of these B-modes would reveal the first evidence for quantum gravity and determine the energy scale of inflation. However, polarized foreground emission from synchrotron radiation and dust in our galaxy's magnetic field are sources of significant contamination for CMB B-mode polarization maps. I propose to develop high-precision photometric calibration technology in order to make the highest possible quality foreground-cleaned polarization maps of the CMB. I will build and characterize a precision Fourier Transform Spectrometer (FTS) with a novel optical coupling scheme that will enable on-site measurements of Advanced ACTPol's detectors' spectral responses. I will develop new anti-reflection coating technology for optical systems to ensure precise calibration. With my calibration in hand, I will then produce foreground-separated polarization maps which will be used to place constraints on inflation, neutrinos and dark energy. The technology I develop will be applicable to all suborbital and space-based CMB, millimeter wave, and submillimeter wave experiments. My work aligns with NASA's goals outlined in the Science Instruments, Observatories, and Sensor Systems Roadmap (TA08.1.4 and TA08.2.2), Materials, Structures, Mechanical Systems, and Manufacturing Roadmap (TA12.1.4), Physics of the Cosmos Program, and Cosmic Origins Program.

Anticipated Benefits

The technology I develop will be applicable to all suborbital and space-based CMB, millimeter wave, and submillimeter wave experiments.



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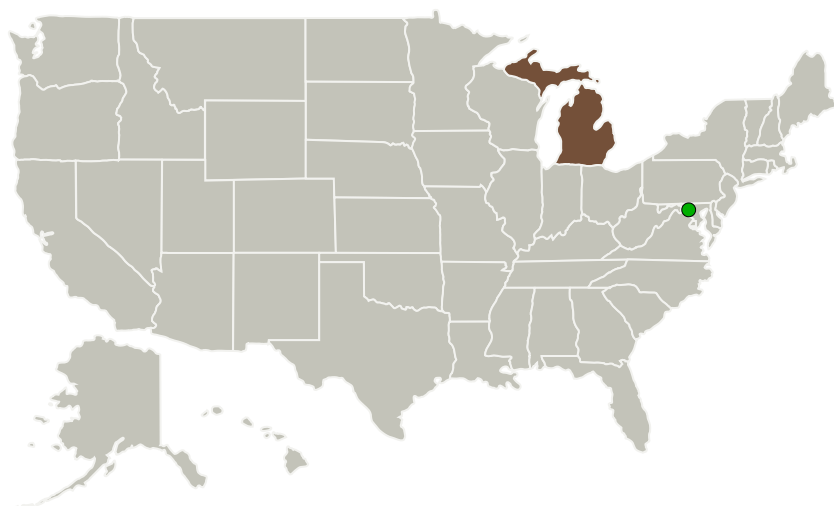
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Michigan-Ann Arbor	Lead Organization	Academia	Ann Arbor, Michigan
 Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Michigan

Project Website:

<https://www.nasa.gov/strg#.VQb6T0jJzyE>

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Michigan-Ann Arbor

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Jeffrey McMahon

Co-Investigator:

Taylor A Baildon

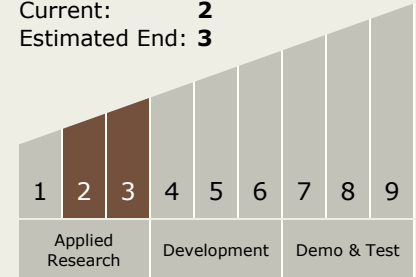
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Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System